

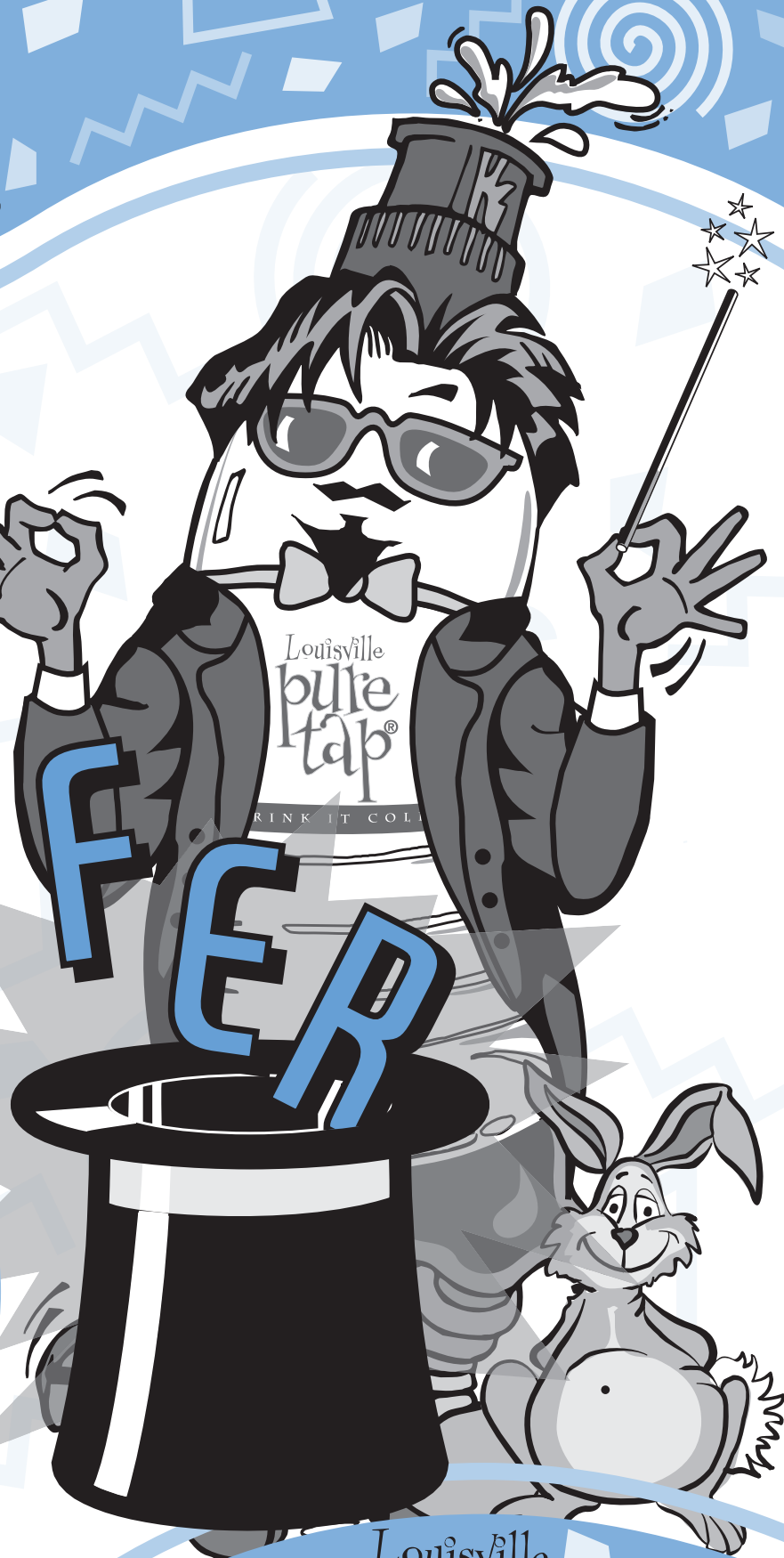
SECTION 8

THE AMAZING AQUIFER

OUTCOME: WHAT STUDENTS WILL LEARN

- What the aquifer is and its role as a natural filter.
- How riverbank infiltration works.

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CORE CONTENT STANDARDS

Science

- SC-E-2.1.1 Earth materials include solid rocks and soils, water and the gases of the atmosphere.
- SC-M-2.1.2 Landforms are a result of a combination of constructive and destructive forces. Constructive forces include crustal deformation, volcanic eruption and deposition of sediment, while destructive forces include weathering and erosion.
- SC-M-2.1.4 Soil consists of weathered rocks and decomposed organic material from dead plants, animals, fungi, protists and bacteria. Soils are often found in layers, with each having a different chemical composition and texture.
- SC-M-2.1.5 Water, which covers the majority of the Earth's surface, circulates through the crust, oceans and atmosphere in what is known as the water cycle. Water dissolves minerals and gases and may carry them to the oceans.
- SC-M-2.2.2 Fossils provide important evidence of how environmental conditions and life have changed.

THE AMAZING AQUIFER

The Aquifer and Ground Water

As rain and snow soak into the ground they create **ground water**. Much of the ground water is held in large layers of earth, gravel and stone called **aquifers**. Think of an aquifer like a sponge with holes. The water is stored in the openings and is drawn to the surface by either a **well** or a natural **spring**.

Over half of the U.S. population gets its water from the ground, in these underground aquifers. The world's largest aquifer is the Ogallala Aquifer which extends from South Dakota to Texas. This aquifer is over 200 million years old and can hold about 250 trillion gallons of water.

Water that comes from the ground usually needs less treatment to be used as drinking water. That's because as the water travels to the aquifer it flows through a layer of soil, rock or sand. The aquifer is nature's "natural filter."

The top surface of the ground water is called the **water table**. The water table fluctuates due to seasonal changes and precipitation. Excessive pumping from the aquifer can also lower the water table.

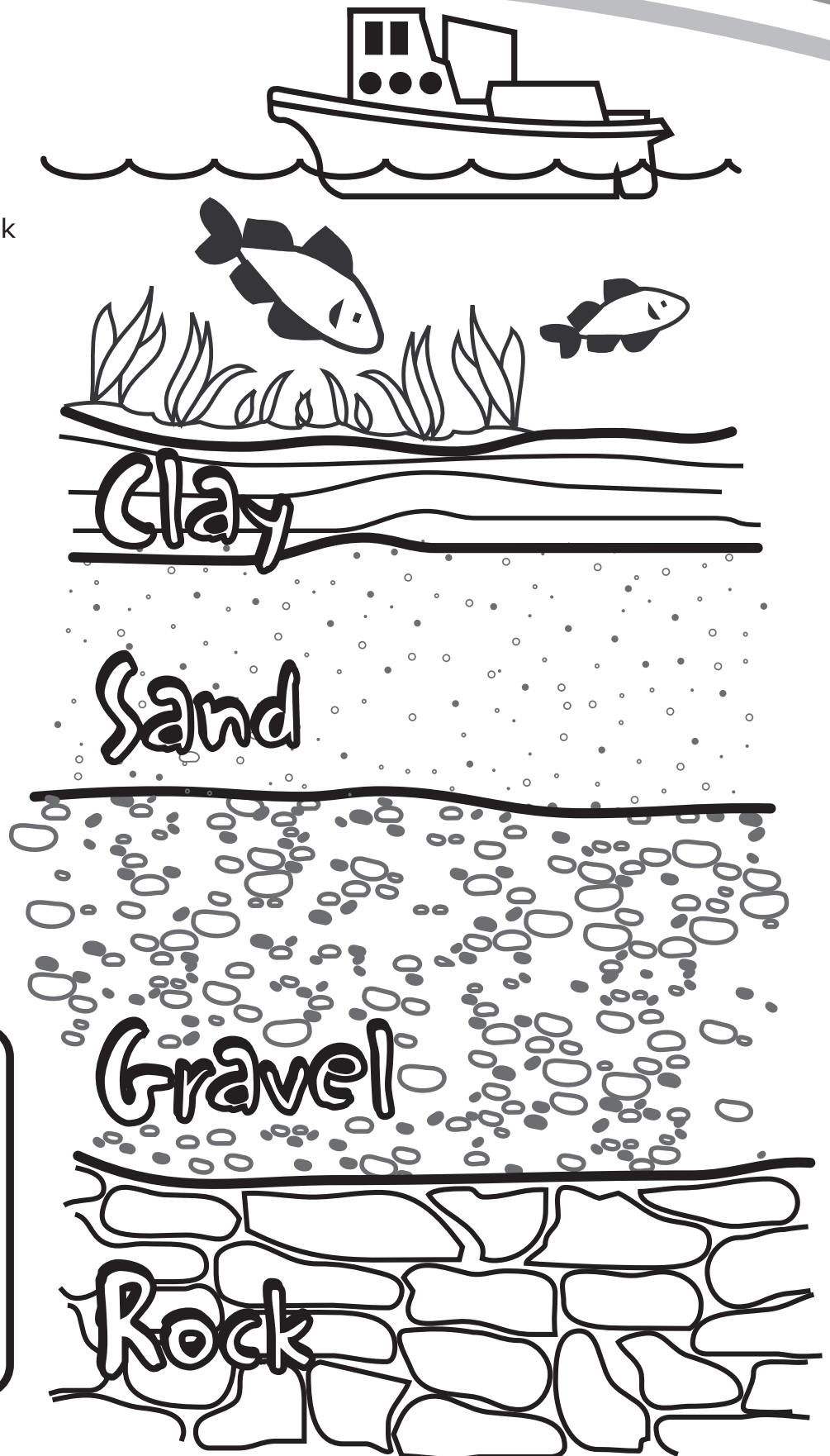


Louisville's Aquifer

An aquifer runs along the bank of the Ohio River in Louisville. If you took a shovel and started digging next to the river you'd find layers of clay then sand, gravel and finally bedrock.

The aquifer has been here for millions of years. This area was a warm, tropical ocean 395 million years ago. Landforms and the Ohio River were carved over time. Today the remains of the fish and plants from that time are under the river. The bedrock found about 100 feet under the river is full of fossils.

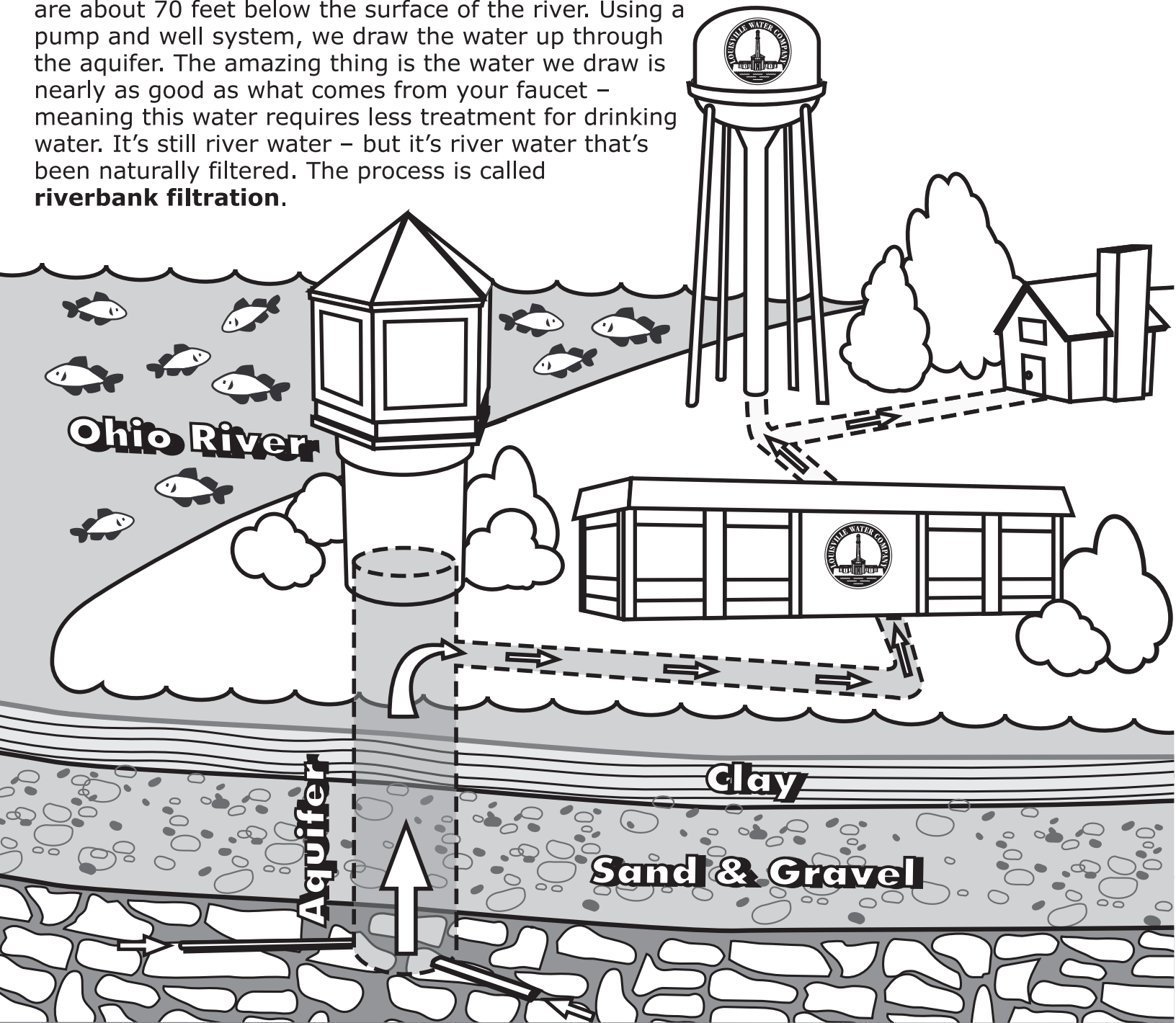
The diagram illustrates the aquifer that's next to the Ohio River. River water that flows down through the sand and gravel is naturally filtered and cleaner than the water on top of the river.



THE AMAZING AQUIFER

Louisville's Aquifer and Riverbank Filtration

Louisville Water Company began drawing water from the aquifer at the B.E. Payne Plant in 1999. Using special equipment, we drilled down about 100 feet into the aquifer and extended laterals (pipes) under the river and into the aquifer next to the river. The pipes are about 70 feet below the surface of the river. Using a pump and well system, we draw the water up through the aquifer. The amazing thing is the water we draw is nearly as good as what comes from your faucet – meaning this water requires less treatment for drinking water. It's still river water – but it's river water that's been naturally filtered. The process is called **riverbank filtration**.

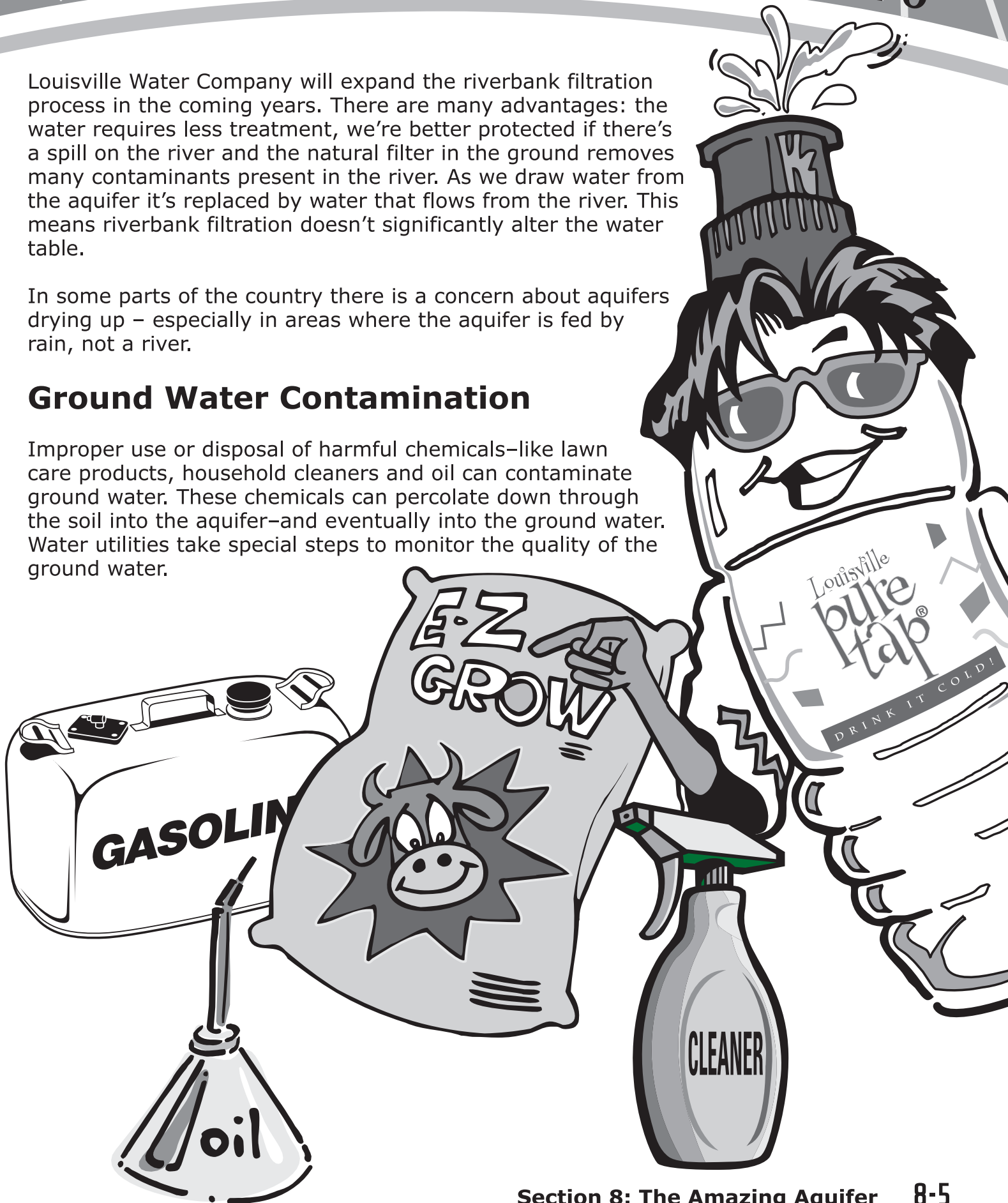


Louisville Water Company will expand the riverbank filtration process in the coming years. There are many advantages: the water requires less treatment, we're better protected if there's a spill on the river and the natural filter in the ground removes many contaminants present in the river. As we draw water from the aquifer it's replaced by water that flows from the river. This means riverbank filtration doesn't significantly alter the water table.

In some parts of the country there is a concern about aquifers drying up – especially in areas where the aquifer is fed by rain, not a river.

Ground Water Contamination

Improper use or disposal of harmful chemicals—like lawn care products, household cleaners and oil can contaminate ground water. These chemicals can percolate down through the soil into the aquifer—and eventually into the ground water. Water utilities take special steps to monitor the quality of the ground water.



WATER WORDS

Aquifer: underground layer of rock or soil that holds water.

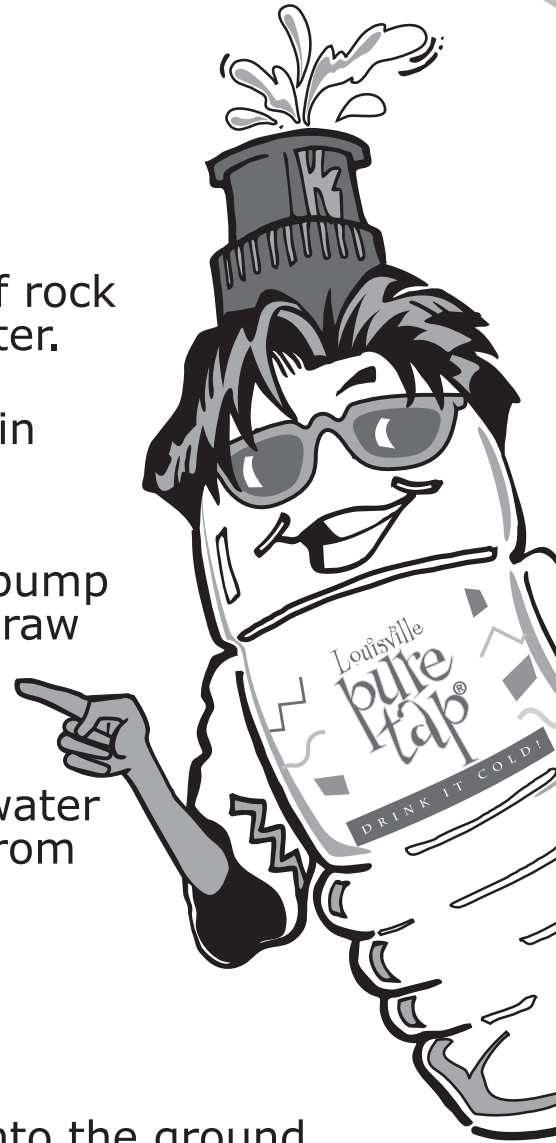
Ground water: Water that is stored in the ground.

Riverbank filtration: Process that uses a pump and well system to draw water from the river into the aquifer.

Spring: A natural source of water that usually comes from an aquifer.

Water table: the top surface of ground water.

Well: A deep hole drilled into the ground to obtain water, gas or oil.



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Activity #1: Aquifer in a Cup

Objective:

Students will understand the components of the aquifer and how it works.

Time:

One hour

You'll need:

- Clear plastic cups
- White play sand
- Water
- Aquarium gravel (white or natural color)
- Modeling clay
- Pumps (from a liquid soap bottle or other spray bottle)
- Blue food coloring
- Nylon stocking
- Small cups
- Rubberbands
- Red kool-aid

Here's what to do...

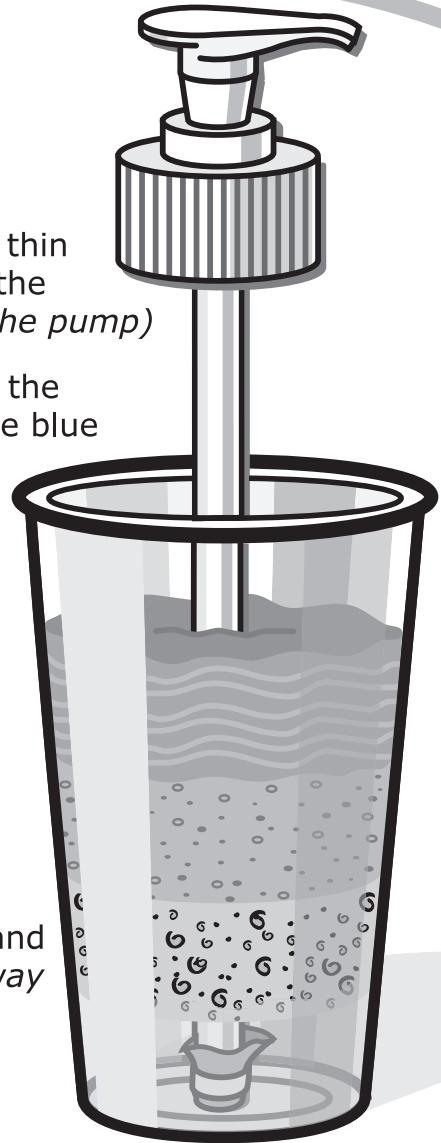
Before the experiment, rinse the gravel to remove any dirt and make a cup of blue water using the food coloring.

1. After students understand the meaning of an aquifer and how Louisville Water Company uses the aquifer, explain to the class they're going to construct a mini-model of what the aquifer is like along the Ohio River.
2. Show students the diagram of Louisville's aquifer on page 3.
3. Divide students into groups and give each group a cup.
4. Explain the cup will represent the aquifer. The bottom of the cup represents the bedrock or the bottom layer of the aquifer.
5. Have the students attach the piece of nylon to the bottom of the spray pump with the rubberband. The spray pump represents the pump Louisville Water Company uses in its Riverbank Infiltration program. Why do we use the nylon? *(The nylon acts like a screen so small particles will not get into the water. Louisville Water Company uses a screen at the bottom of our pump in the aquifer.)*
6. Have one student place the pump in the center of the cup and hold it. The bottom of the pump should not rest on the bottom of the cup.
7. What's above the bedrock? (*gravel*) Have students fill the cup about 1/4 with gravel.
8. What's above the rock? (*sand*) Have students place about one inch of sand on top of the gravel.



Activity #1: Aquifer in a Cup (continued)

9. What's above the sand? (*clay*) Have students place a thin layer of the clay around part of the cup. Don't cover the entire part of the sand. (*You'll have to work around the pump*)
10. Give each group a small cup of blue water. Explain to the students this represents rain. Slowly pour some of the blue water into the cup. Watch what happens. (*You'll see the water fill in the holes between the rocks and soak into the sand.*) Keep pouring until you see a water table appear. (*You'll see water near the top of the clay*)
11. Now, it's time to get the water! Have one student start pumping the pump. Have another student hold a cup to catch the water. Watch what happens. (*The water will come out of the pump—it may take a little while. You should see the water table drop.*)
12. Now, demonstrate the effects of improperly disposed chemicals. Let's say you changed the oil in your car and you put the old oil down the drain. (*Not the correct way to dispose of oil!*) Take some of the red kool-aid (oil) and sprinkle it on top of the sand part of the aquifer. (*The part of the aquifer you didn't cover with clay.*)
13. Now make it rain by slowly pouring a little water from a cup over the kool-aid. Watch what happens to the kool-aid. (*You'll see it seep into the aquifer.*)
14. Now pump more water from the aquifer. What happens? (*The water you pump will eventually change from blue to either red or a green color.*)



What did you learn?

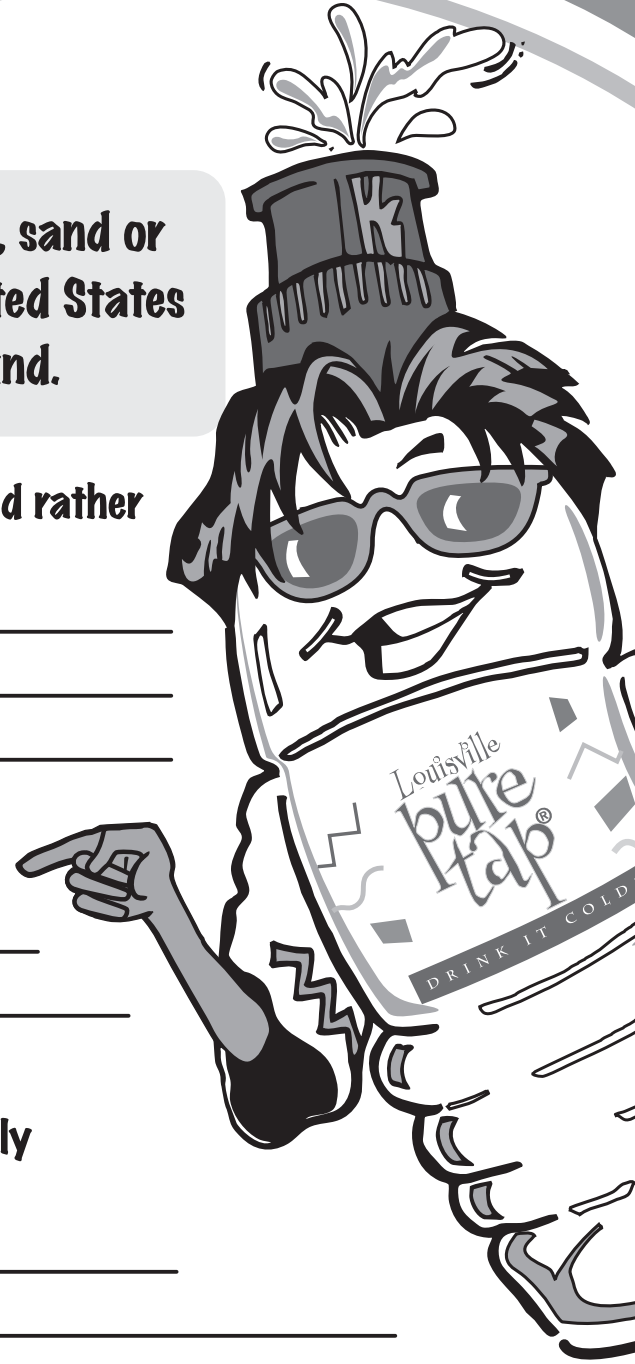
- The aquifer is made of clay, sand, gravel and bedrock.
- Pumping water from the aquifer can lower the water table.
- Improper use or disposal of chemicals can hurt the quality of ground water.

Open Response Question

An aquifer is an underground layer of rock, sand or soil that holds water. Most people in the United States get their drinking water from the ground.

A. Describe a benefit of taking water from the ground rather than from a river.

B. Explain how weather might affect the water supply in the aquifer.



Open Response Question

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SCORING GUIDE

- 4**—Student describes the benefits of ground water (better quality, important if no river is close by, water moves through the aquifer and many contaminants are filtered out) and correctly explains how rain or a drought impacts an aquifer.
- 3**—Student describes the benefits of ground water, but has a limited understanding of how weather impacts the water supply.
- 2**—Student has a limited understanding of the benefits of ground water and has minimal understanding of filtration and weather's impact on the water supply.
- 1**—Student incorrectly lists benefits of ground water and has minimal understanding of filtration and weathers' impact on the water supply.
- 0**—No attempt or relevant answer.

Look for:

- An aquifer holds ground water.
- An aquifer naturally filters water.
- In some places where aquifer is fed by rain, a drought or minimal rainfall can affect the amount of water in the aquifer.



THE AMAZING AQUIFER

Check out these opportunities to keep the learning flowing!



Books:

Hoff, M., Rodgers, M. (1991). *Groundwater*. Minneapolis, MN: Lerner.
Resource and reading material for students.

Web sites:

www.epa.gov/seahome/groundwater/src/geo2.htm *Learn about groundwater and aquifers.*

www.falloftheohio.org *Web site for the Falls of the Ohio State Park.*

Louisville Water Company Opportunities:

LWC can come to your classroom and do more experiments and show additional illustrations on the aquifer. Call the Public Information Department at 569-3600.

www.tappersfunzone.com *Click on "Teacher Tools" for a supplement to this section.*

Extra, Extra, Extra!!!